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ADDRESS REPLY TO
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FEDERAL BUILDING,
ASHEVILLE, N. C.

R - AP
Investigative Program

June 3, 1937

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Dear Sir:

The Sixteenth Annual Report and Program of the Appalachian Forest Experiment Station is enclosed.

Comments on the Station's results and proposed program are invited.

Very truly yours,

Ralph M. Nelson

Ralph M. Nelson
Acting Director

Enclosure.

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May 11, 1937

U. S. DEPARTMENT OF AGRICULTURE

FOREST SERVICE

APPALACHIAN FOREST EXPERIMENT STATION

Asheville, N. C.

SIXTEENTH ANNUAL REPORT AND PROGRAM

1936 - 1937

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SIXTEENTH ANNUAL REPORT AND PROGRAM

APPALACHIAN FOREST EXPERIMENT STATION

1936 - 1937

Station Headquarters - Federal Building, Asheville, N. C.

Branch Stations and Experimental Forests

Bent Creek - Pisgah National Forest, Asheville, N. C.

Coweeta - Nantahala National Forest, Franklin, N. C.

Fernow - Monongahela National Forest, Parsons, W. Va.

Toccoa - Chattahoochee National Forest, Blairsville, Ga.

Santee - Francis Marion National Forest, Witherbee, S.C.

Cooperating Experimental Forests

Berea College Forest - Berea, Ky.

Georgia Mountain Experiment Station Forest - Blairsville, Ga.

de la Howe Industrial School - McCormick, S. C.

Copper Basin - Copperhill, Tenn.

APPALACHIAN FOREST EXPERIMENT STATION

PERSONNEL

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Coel W. Mills	Administrative Assistant
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Mary P. Gudger	Senior Stenographer
*Ruth Patterson	Ass't. Clerk-Stenographer
*Evelyn Curtis	Junior Clerk-Typist
*R. E. Powell	Ass't. Conservationist

Forest Management - Mountain Hardwoods

Leonard I. Barrett	Silviculturist
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Forest Management - Piedmont and Coastal Plains

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William A. Parr	Field Assistant
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Planting Investigations

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Fire Investigations

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*W. B. Mayer	Assistant to Technician

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*Earl J. Rogers	Junior Forester
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*Henry Gores	Messenger
*Helen M. Moore	Messenger
*W. E. Lewis	Junior Assistant to Technician
*Charlie L. Shope	Junior Assistant to Technician
*H. A. Pickelsimer	Foreman

Forest Survey

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*Chas. H. Carr	Technician
*W. F. Mershon	Technician
*R. L. Moseley	Technician
*D. J. O'Kelley	Technician
*A. D. Toler	Technician
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*J. H. Blackerby	Assistant to Technician
*Robt. W. Bryce	Assistant to Technician
*Wm. P. Coggins	Assistant to Technician
*L. E. Fisher	Assistant to Technician
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Bent Creek, Pisgah N. F., North Carolina
*W. A. Nesbitt, Acting Superintendent

Coweeta, Nantahala N. F., North Carolina
*R. A. Hertzler, Acting Superintendent

Toccoa, Chattahoochee N. F., Georgia
*James F. Renshaw, Acting Superintendent

Fernow, Monongahela N. F., West Virginia
*W. W. Myers, Foreman

*----Paid from emergency funds

COOPERATING AGENCIES

Forest Entomology - Bureau of Entomology & Plant Quarantine

B. H. Wilford	Associate Entomologist
R. J. Kowal	Junior Entomologist
H. R. Johnston	Junior Entomologist
C. B. Eaton	Junior Entomologist

Forest Pathology - Bureau of Plant Industry

_____ In Charge

SIXTEENTH ANNUAL REPORT AND PROGRAM

APPALACHIAN FOREST EXPERIMENT STATION

ASHEVILLE, N. C.

NEW DEMANDS ON FOREST RESEARCH

Two major developments of the past year have served further to emphasize the importance of the role of forestry in the social and economic structure of the territory of the Appalachian Forest Experiment Station[1/] and to place new demands on forest research if the problems involved are to be coped with successfully. These are the expansion of the pulpwood industry, and the great floods of 1937. There has been renewed realization in recent years of the part that forestry can play in land use and in promoting the welfare and stability of dependant population by realizing on the forest crop as a greater source of income from the land, of raw materials for industry, and of labor income, and as a means of controlling soil erosion and regulating streamflow. The growth of the pulp and paper industry and the recent floods are but realistic expressions of the importance of forestry throughout the region.

The new pulp and paper industry will provide a market for certain products of forest land not heretofore readily marketable, which, if removed in the proper manner, can be made to improve conditions for growing all kinds of forest products. It will provide extensive new employment in the woods and in the mills. It will contribute directly or indirectly to almost every phase of business, including agriculture, in the region. It adds new significance to the use of land for timber growing. All of these things are very much to be desired.

On the other hand, the whole future of existing forest products industries, including lumber manufacturing, poles, piling, and naval stores, as well as of the pulp and paper industry itself, depends in a very large measure on the wisdom with which timber cutting is carried on. Most important of all the permanence and stability of livelihood of the people who are or become directly or indirectly dependant on these wood using industries is contingent upon forest cutting practices which will maintain and build up the timber supply. There is an apparent abundant

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1/ The Appalachian Forest Experiment Station is one of 12 regional forest experiment stations of the Forest Service, U.S. Department of Agriculture, in the United States. Its territory includes Virginia, West Virginia, North Carolina, South Carolina, northern Georgia, and eastern Tennessee and Kentucky. The more important forest areas include the hardwood forests of the Southern Appalachian Mountains, the oak-pine forests of the Piedmont and the southern pine and bottomland hardwoods of the Coastal Plain.

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supply of second-growth timber in the region at the present time to provide the needed supplies of wood for several years to come. However, if the land is cut over without provision for continuous renewal of the forest crop, it will be a matter of only a few years in many localities before this supply is exhausted. The average annual cut of timber must not exceed the average annual growth if the dependant industries and population are to be sustained. Moreover, the existing pine forest area, on the whole, is generally understocked with timber growth; therefore, in addition to restriction of cut to the current rate of growth, a part of the annual growth during the next several years should be left intact to build up the timber capital necessary to sustain the growing dependence on timber supplies. Moreover, since smaller sized trees can be used for pulpwood than for many other purposes, cutting should be practiced in a manner to leave a sufficient quantity of young trees to grow to maturity for the other industrial uses. Good forest practice can accomplish all these things but if unregulated cutting takes place so as to leave insufficient young trees to mature for the other wood using industries, or to prevent or delay the reforestation of cut over lands, the entire future becomes precarious.

Enough is known about cutting procedure to make a large beginning in proper forest practice now. It calls for the correlated efforts of all wood using industries and all timberland owners. However, as a sound forestry program develops there will be need for more and more refinement in woods practice. This calls for additional research to provide more and better information on practically every aspect of forestry, including methods of cutting, planting, protection from fire, disease and insects, preparation of products and the many economic phases of the problem. Research should be far enough in advance of need for application to have methods and technology worked out as needed.

The flood situation calls for bringing into use every economical form of flood control, including the development of forestry and other land use practices which will increase retention of potential flood waters in the watersheds. Enough is known now to indicate the place of forestry in this program and for great progress to be made, but information is lacking as to the kind of forest cover that should be maintained for each of the great variety of watershed conditions, and as to how forest cover should be managed for watershed protection and at the same time make the best economic use of the forest growth without detracting from the protective value of the forest cover.

MANAGEMENT OF MOUNTAIN HARDWOODS

Accomplishments During the Past Year

Timber Stand Improvement Investigations

A study of the effect of heavy release and light release, as compared with no release, on individual crop trees of various crown classes was begun in the "a" age class of northern hardwoods. Six hundred sugar maple crop trees were treated on a 35 acre plot bearing a 13-year old stand, and averaging 22 feet high, on the Monongahela National Forest. White oak was selected as the species for study on the Jefferson National Forest, where 225 crop trees on two plots totaling 10 acres were treated in a stand 14 years old and averaging 18 feet high.

Results in a stand of good site cove hardwood reproduction treated when 6 years of age indicate that the effects of a cleaning cutting has largely disappeared after 3 years. The competing vegetation after 3 years was as high, or higher, than before the treatment was made. Many crop trees which were freed by the cutting, however, have been able to maintain a dominant position in the stand. Although the experiment has not been under way long enough for final conclusions, indications are strong that if a high proportion of the trees originally favored in stands of this age are to remain free, recleaning at a 3-5 year interval will be necessary.

Dogwood Sprouting

Measurements made during November, 1936, on sprouts arising from the stumps of 324 dogwoods cut at different periods during 1934 show that there is a significant difference between the sprouting capacities of stumps cut at the different periods. The height and diameter of the sprout clumps was less for stumps cut the first of August than for those cut at any other time. The total length of sprouts was least for stumps cut early in July.

Methods of Cutting

A cutting method experiment was established on a 50-acre tract of all aged cove hardwoods averaging 8.7 M feet per acre on the Bent Creek Experimental Forest. The area was subdivided into 50 one-acre plots, and five different amounts of stand to be reserved were assigned at random over the area, giving 10 one-acre replications of each. The volume of residual stand assigned to the various plots were 0 or clear cutting, 1 M, 3 M, 5 M ft. B.M. per acre, and checks on which the entire stand was reserved. The stand marked to remain on the partially cut areas consisted of the youngest and thriftiest of the growing stock.

The records are set up so as to show by 5-year intervals, the influence of the various amounts of residual stand upon (1) the volume growth, thus indicating the period required again to produce a merchantable cut; (2) the quantity and growth of desirable reproduction; and (3) the development of epicormic sprouts.

Tree Classification for Hardwoods

An exploratory study was initiated to determine the possibility of developing a tree classification for hardwoods as a guide for timber marking and other silvicultural work. Work during the year was limited to white oak as planned. In approaching this problem, it was assumed that any descriptive method of classifying trees should provide an accurate expression of the following:

1. Current growth rate of merchantable stem.
2. Proportion of recurrent growth rate being put on grade 1 and 2 logs as an expression of quality growth.
3. Development of epicormic sprouts on residual trees after partial cutting.
4. Ability to respond to release.
5. Seeding capacity.

To be of most useful value, the above factors must be determined by use of tree characteristics which are quickly and easily estimated or measured in the field.

Of the five factors, the first and second may be studied by means of stem analysis on felled trees. Number 3 is a relatively short time study requiring 3 to 5 years' observations on partially cut areas, while 4 and 5 are long-time studies, requiring possibly 10 to 15 years of observation before useful conclusions can be reached. The study for the first year was limited to an investigation of which tree characteristics gave the best estimate of current annual growth percent based on board foot volume and whether or not these characteristics would afford a sufficiently accurate method of estimating current growth on individual trees.

The tree characteristics first tested were DBH, crown ratio, flatness index of top, percent of major limbs dead, and location of tree on the slope. All of these factors can be quickly measured or estimated and have always been considered in marking timber for cutting, although no systematic effort has been made to evaluate their value for the purpose.

Stem analyses and descriptions of 77 trees were obtained from four national forests in Region 8. The multiple correlation method was used to derive for the group of trees from each Forest an equation, based on the tree characteristics mentioned previously, by which the current annual growth percent of single trees was estimated. Further

analysis of the data showed that for white oak, inclusion of the flatness index and location on the slope added very little to the accuracy of estimate. It was also found that the use of the five tree characteristics mentioned did not allow for sufficiently accurate estimates to be of practical use, but that the greater part of the error could be removed if tree age and crown width ratio were substituted for flatness index and location on the slope. The necessity for considering age detracts somewhat from the desirability of the equation because it involves obtaining sufficient knowledge of the range of ages in a given stand so that estimates of age can be made for individual diameter classes by 50-year age classes.

The work has further indicated that with five tree characteristics showing up as important in the determination, the development of a set of tree classes will not lend itself to simple graphic methods and that the use of formulae will be the more useful method of expressing tree class. For practical application in the field, however, the formula is cumbersome and time-consuming. Expressions of formulae as alignment charts is one method of increasing the ease of use. Although it has not yet been tried, there is a possibility that the formula may be expressed in a form similar to the fire danger meter developed in Region 1.

Pruning White Pine

It was considered inadvisable to establish the series of cutting plots on the Toccoa Experimental Forest as originally planned. The time previously allotted to this work was devoted to a pruning study in a mixed white pine-hardwood stand. The area selected had been treated in 1934 by a cultural crew, whose work was confined chiefly to the girdling of defective hardwoods in order to release the 20-year-old white pine understory, which varied from 2-7 inches in diameter and from 15-50 feet in height.

The objectives of the pruning experiment are to determine for such a white pine stand (1) the influence which various degrees of pruning in the living crown have on subsequent height, diameter, and volume growth; (2) the lumber defects which may result from the pruning of live limbs; and (3) the ultimate value of the lumber produced by pruned and unpruned trees when adjusted for pruning costs.

A total of 400 trees were measured and described, 100 of them being checks and the remaining 300 equally divided into those having 30, 20, and 10 percent of their living whorls removed in addition to the dead limbs.

Actual pruning was done with a short handled saw for removing lower limbs, and hand-made models of the pruning tool designed by J. H. Rich, and described in the Journal of Forestry for December, 1935, were mounted on 6-foot handles with 8-foot extensions for pruning between 8 and 20 feet. A few of the tallest trees, requiring pruning up to 28 feet, were climbed and pruned entirely with the saw.

Using these methods, an average of 6 minutes per tree was required to prune the 300 trees. Of this total average time, 2.5 minutes was used in the actual pruning operation, and 3.5 minutes was charged to walking between trees and other lost time. The average actual pruning time varied from 1.9 minutes for the lightly treated trees to 3.25 minutes for the heaviest treatment.

Planting vs. Natural Reproduction

Three chestnut coves were selected which were nearly clear cut by removal of the chestnut acid wood, on the Bent Creek Experimental Forest. A study was started to compare the efficiency of planting and natural reproduction in restocking chestnut areas. Each area was divided into small squares and alternate squares were under planted with yellow poplar. One half of each area was fenced against deer to observe the influence of deer browsing on both planted and natural reproduction where the concentration of deer has been determined as one head to 35 acres.

Plans for 1937

The cleaning study begun last year with sugar maple and white oak is to be extended to include white pine, yellow poplar, and northern red oak.

A study is planned to determine what improvement can be brought about in the composition of the second growth by cleanings in the reproduction in a hardwood forest 6 years after clear-cutting.

In order to determine the value of a second cleaning, where the effect of the first is apparently disappearing, one-half of the subplots in an area of hardwood reproduction first cleaned at the age of six years will be again cleaned during the summer of 1937. Since there are four replications of each type of treatment, the lay-out lends itself well to this repetition of treatment, and the influence of a second cleaning three years after the first can be compared with the value of only one treatment.

Because the tree class study has shown considerable promise and because the information it provides is basic to a more intelligent establishment of partial cutting experiments, it is planned to concentrate during the coming year on a continuation of the tree class study. Two additional species will be chosen. The study should ultimately include yellow poplar, northern red oak, chestnut oak, white pine, shortleaf pine, sugar maple, black oak, scarlet oak, hemlock, black cherry, and white ash.

Administrative studies, to be undertaken by the national forests, dealing with (1) intermediate cuttings in stands old enough to produce merchantable small timber products, and (2) the financial aspects of

such intermediate cuttings, and of cleanings, have been proposed. If these studies are approved, the Station will assist by preparing the plans, and later on by analyzing the data.

The following jobs of analysis are also planned for the year:

1. White pine release plots. Records have been completed of five years' growth of a white pine understory treated under methods closely approximating those used by timber stand improvement crews. Analysis of the data will provide the first concrete information on the growth following treatment as compared to no treatment.

2. Similar computations for the stand of cove hardwoods first treated at the age of 6 years will be completed. Records of three years of growth following treatment are now available.

3. At the end of the coming growing season, records of two years' growth of the white pine pruning study will be available and will be analyzed.

4. Analysis of the white oak tree class data will be continued with particular reference to the relationship between quality growth rate and tree characteristics.

5. Two years' seed trap records are available for 210 trees of five species of oaks, which will be studied to discover if the data indicates any apparent relationship between seed production and tree characteristics.

6. The dogwood sprouting study which was designed to show the influence of season of cutting upon subsequent sprouting will need some further analysis.

Urgent Problems

1. Partial cutting studies in sawtimber stands are listed as among the urgent problems this year, instead of among the going projects as in last year's report, since it now seems more desirable to complete the tree class study before extensive series of partial cutting plots are established.

2. Determination of those cultural methods and their relative costs which will increase the proportion of desirable species in stands poorly stocked with these species.

3. Utilization and forest products studies concentrating on the economic and silvicultural aspects of harvesting various species for special products. The manufacturing and economic set-ups which will allow for the most diversified use of the wide variety of species available in the Appalachian Region.

4. Correlation of silvicultural practice with production of wild life so that the maximum benefit from the land can be obtained.

5. Tree physiology studies. The removal of undesirable trees in cultural work, the development of epicormic sprouts after partial cutting and many planting and nursery problems depend for final solution upon fundamental research in plant physiology.

——— Leonard I. Barrett

STUDY OF CUT-OVER AREAS IN THE MOUNTAIN REGION

Accomplishments During the Past Year

As a basis for appraising and improving the cutting practice in Southern Appalachian mountain forests the Station has collected extensive records of conditions following cutting, and similar records have become routine procedure on the national forests. The compilation of all available cut-over area data was a Station activity during the past year, but was not completed and much remains to be done.

While it was recognized that in the last analysis each cut-over area is a case in itself, not comparable with any other area in at least some respects, much of the work during the year consisted of classifying the areas in groups representing generally comparable characteristics of composition, sprout or seedling origin of reproduction, basal area and qualify of residual stand, etc. An analysis of similarities and differences should throw light on the relative efficiency of past methods and should contribute, with other Station investigations, toward improving silvicultural practice.

Plans for 1937

The compilation of the results at hand will be continued for publication, and the study will be extended to the second examination records made by the national forests on areas previously surveyed. It is hoped also to obtain further data on crown expansion of residual trees from some of the Station's permanent sample plots.

Urgent Problems

1. Forest succession following cutting.

Marked changes in stand composition after cutting - the initial radical change and the sequence that follows - should be identified for different forest types as a basis for deciding upon the need of silvicultural measures and as a means for recognizing the series to which any particular phase belongs.

2. Relations of residual stand to reproduction.

The rate of crown closure of the trees in residual stands of different stem densities and in different types and sites should be determined, as a means of ascertaining desirable degrees of cutting and of interpreting the significance of reproduction density.

——— E. H. Frothingham

MANAGEMENT OF PIEDMONT OAK-PINE FORESTS

Accomplishments During the Past Year

The Mid-Atlantic Piedmont Region embraces an area of 30 million acres in Virginia, North Carolina, and South Carolina, extending from an imaginary line running through Richmond, Virginia, Raleigh, North Carolina, and Columbia, South Carolina, west to the foot of the Blue Ridge Mountains. Prior to July 1, 1936, practically no cognizance has ever been given to the problems of handling the 17 million acres of forest land in this belt. During the past six months, as a background for selecting specific problems for intensive study, an attempt has been made to build up a working knowledge of the forest conditions and problems, as well as to develop a picture of the economic background and its implications which must be considered in the future forest practices of the Region.

Recognizing the importance of forest practice on the 62.5 percent of the forest land area on farms, a sample preliminary forest management plan was prepared for a small tract in South Carolina, in collaboration with the South Carolina State Forestry Commission and the Sumter National Forest. The preparation of this plan emphasized the lack of information in most of the fields of forest practice and indicated certain problems as having immediate urgency. In the course of this work, 32 semi-permanent methods of cutting plots and 79 growth plots were established. Other valuable data on rate of growth and stand conditions were collected and are in the process of analysis.

A study of the periodicity, rate, and amount of seed fall in a clear cut area between two parts of a 70-year-old loblolly pine stand was started in cooperation with Duke Forest. Fifty one-fourth milacre seed traps were set up in a 5 x 5 Latin Square design. These traps were examined weekly, starting on October 14. The first loblolly pine seed was found in the traps on October 17. The maximum fall of over 100,000 seeds per acre occurred during the week of November 18 and seeds were still falling on February 4. The following table presents some of the results of the study to date.

Loblolly Pine Seed Fall

Date Week Ending	Mean Number Seeds per Acre	Standard Error %	Cumulated Pounds per A.
October 21	400	---	.02
October 28	3,440	25.5	.18
November 4	49,600	9.5	2.51
November 11	29,520	9.4	3.89
November 18	101,760	4.7	8.67
November 25	12,560	11.5	9.26
December 2	15,280	11.1	9.98
December 9	3,200	23.1	10.13
December 16	800	38.0	10.17
December 23	4,560	15.4	10.38
December 30	5,920	15.3	10.66
January 6	80	---	10.66
January 13	320	---	10.68
January 20	240	---	10.69
January 27	160	---	10.70
February 4	1,520	42.2	10.77

Other results indicate that the heaviest fall of seed was under the uncut stand but that all parts of the clear cut strip received the equivalent of at least 6 3/4 pounds of loblolly pine seed per acre.

Preliminary reconnaissance of the factors affecting the natural and artificial revegetation of abandoned old fields indicated need for further research.

Plans for 1937

The preliminary work on the project to date indicates four broad problems as being of outstanding importance. These problems deal with (1) the rate of natural reforestation of depleted and abandoned old fields, (2) the silvical and growth characteristics of Virginia pine, a species concerning which very little is known, (3) methods of encouraging stands of desirable reproduction already established and benefitting growth rate and composition of stands beyond the juvenile stage, and (4) the factors affecting the natural establishment and early development of mixed pine-hardwood forests. Proposed plans for the coming year call for inauguration of work on the first three of these problems and possibly on the fourth. The first work on all of these will be of extensive nature and will be used to guide the development of further more intensive investigations. Before the final selection of phases of work, it is planned to confer with all interested foresters in the region.

Thousands of acres of abandoned old fields need reforestation. Some of these lands will become reforested naturally while others will have to be planted. The study of the rate of natural reforestation of depleted and abandoned old fields should give at least a broad basis for determining lands which will become reforested naturally in a reasonable length of time, as well as those on which planting will have to be resorted to. Cooperative work with the planting project will also aim at the comparison of results to be obtained from planting as compared to natural reforestation.

Virginia pine, although generally regarded as a poor quality species, is of such widespread occurrence in the Region that a knowledge of its silvicultural and growth characteristics is essential to determine its place in the handling of a large acreage of timber land. Accordingly, a short-time study of the rate of growth and silvicultural characteristics of the species is proposed.

The need of improving composition and quality increment in many old field pine stands is self-evident, particularly in the southern part of the region. Accordingly, it is planned to start a study of methods and costs of thinning and pruning loblolly and shortleaf pine stands in cooperation with the Sumter National Forest.

The largest single question facing the forest land owner in the Region is how to convert stands of low value, poor-quality hardwoods, which once contained considerable proportions of pine, back into mixed pine-hardwood stands, and how to retain this mixture after it is once achieved. The answer to this question lies in two separate studies, one dealing with stand improvement operations, and the other with methods of encouraging desirable reproduction, and of discouraging establishment of undesirable reproduction. In the second study, a thorough understanding of the factors affecting establishment and early development of reproduction of various species will give the best possible foundation for further work. The inauguration of this study will probably be delayed until late in the year, pending exploratory field work on selected areas.

——— A. L. MacKinney

MANAGEMENT OF SOUTHERN PINES - COASTAL PLAIN

Accomplishments During the Past Year.

Following past policy, all work on the project dealt with loblolly pine, the most common and most commercially important species in the Region. No new studies were started because of almost complete lack of funds for the project. The accomplishments discussed below were all achieved in carrying on studies previously started.

The manuscript for a bulletin on the growth and preparation of loblolly pine pulpwood was completed and will soon be submitted to a board of review. This manuscript summarizes most of the available information and presents much new data on methods of growing and harvesting loblolly pine pulpwood.

New volume tables and site index curves for loblolly pine were presented in Technical Notes Nos. 21 and 22. The site index curves for the first time take into account differences in height of trees caused solely by the density of stocking of stands in which they were growing. The following table shows the amounts by which height of trees is reduced by openness or extreme density of stands in which they grow:

Stand Density %	STAND AGE - YEARS: 10	20	30	40	60
	Amount of Height Reduction (Feet)				
20	3.9	6.4	7.4	8.0	8.8
40	3.3	5.4	6.2	6.6	7.2
60	2.0	3.5	4.0	4.3	4.7
80	0.6	1.0	1.2	1.3	1.4
100	0	0	0	0	0
120	1.3	2.0	2.3	2.6	2.8

Twenty thousand one-year-old loblolly pine seedlings, grown from seed collected from 190 carefully described loblolly pines, were planted on the Francis Marion National Forest. These seedlings were examined and described after planting and again at the end of the growing season. The average mortality during this first summer, which included two months of severe drought, was only 19.7 percent. Preliminary analysis of these

data indicate that the two most important factors affecting mortality in addition to the drought were characteristics of parent and depth of planting. Continued observations on these seedlings will give valuable information on the effects of judicious seed tree selection in planting and cutting practices.

Plans For 1937

In view of the limited funds, no field work is planned in this project during the coming year, except to continue several phases of the study of loblolly pine, a species of importance in the lower Piedmont, as well as in the Coastal Plain. As much time as can be spared from work on other projects will be put on the analysis of a considerable volume of existing data. Analysis of these data should

1. Indicate the characteristics of a loblolly pine tree which influence the amount and quality of seed produced.

2. Assist in setting up a tree classification for loblolly pine based on external characteristics.

3. Throw some light on the factors affecting establishment and growth of loblolly pine reproduction.

Urgent Problems

The drain on forest lands in this region is rapidly approaching the growth. If the harvesting of timber crops increases as it is bound to do because of accessibility to markets, easy logging conditions, and good transportation facilities, at least partial devastation is bound to result unless sound forest management practices are followed. Unfortunately even a reasonably complete knowledge of the practices to recommend is lacking. Accordingly, if the numerous industries dependent on the forests for a continuous supply of pulpwood, poles, piling, crossties, excelsior wood, barrel staves, and lumber, are to continue operation, an extensive forest research program embracing all of the important forest types and species in the Coastal Plain should be inaugurated immediately. Some of the important problems the solution of which is basic to development of an integrated and continued program of forest production may be listed as follows:

1. Methods of cutting studies to determine how stands should be cut in order to insure succeeding stands of valuable species.

2. Studies of rate of growth are the only method of answering the question, 'Shall we cut these trees for pulpwood or will a greater return be realized if they are allowed to grow to sawlog size?', and many others.

3. The problem of when, where, and how to thin forest stands for greater volume and value production is becoming increasingly important with the ever broadening practice of forest protection, and with the increasing market for small sized forest products.

4. If pine, the most valuable species, is to retain its predominance in stands, many areas will have to be treated with cleaning and liberation operations. Studies of economical methods and desirable severity of treatment are necessary.

——— A. L. MacKinney

FOREST PLANTING INVESTIGATIONS

The initiation of research in planting has been greatly delayed owing to difficulties in obtaining properly qualified personnel. One Junior Forester has been selected and we are still looking for a man to head the project.

The work thus far has been confined to compilation of general information preliminary to defining the planting problems in the Region which should receive major emphasis in the program. Tentative conclusions are that major emphasis should be placed on field planting practices, including classification of sites for planting, selection of species, quality or condition of planting stock, and methods and time of planting. Minor emphasis will be placed on nursery practice, especially with reference to hardwood species. Although nursery practice with regard to conifers has been well developed, there are many problems still requiring attention and some time should be devoted to them.

It seems apparent also that the efforts of the Station should be devoted to the more fundamental aspects of the planting problems outlined above. The agencies engaged in planting, including the Forest Service, Soil Conservation Service, Tennessee Valley Authority and the States, all carry on more or less of empirical studies in planting and it is doubted if the Station should aim to take over or extend this line of work. Such studies are best adapted to handling as administrative projects. However, they will serve as valuable guides and supplements to the more fundamental studies carried on by the Station. The Station will want to review the results of these administrative studies and will be glad to assist in the interpretation of results and in planning additional administrative projects. A thorough survey of past accomplishments and results in planting done to date might be in order at this time as a guide, both to future planting programs and to developing the research program. The Station would be willing to cooperate in such a study if the Regions see fit to undertake it at this time.

——— C. L. Forsling

FIRE INVESTIGATIONS

Accomplishments During the Past Year

A detection plan was prepared for the French Broad Division of the Pisgah National Forest, an area of approximately 750,000 acres. Methods for visible area mapping were tested and modified for eastern conditions. Based on visible area maps, and risk and hazard zones, the relative value of 54 points for detection purposes were computed, following in general the method used in California. Assuming a radius of visibility of 10 miles, and after deducting for overlapping areas seen from other points, the erection of 37 towers would provide direct coverage of 85 percent of the district, and 20 towers would provide 61 percent coverage. Under average haze conditions, however, coverage is reduced to 61 percent and 46 percent respectively.

Similar projects are being conducted by the Jefferson, George Washington and Cherokee National Forests. The Station is assisting by contributing some general supervision of the work.

A manual for visible area mapping was prepared and a training school held for representatives of eleven eastern national forests under facilities provided by the Jefferson National Forest.

Seventeen hundred haze meter readings from two lookouts on the French Broad Division for last spring's fire season were analyzed and a curve of visibility distance on percent of days for that period and Division presented in a technical note.

The Station assisted Region 7 in preparing record forms for haze meter readings and weather observations. Data obtained for last fall's fire season in that Region are being analyzed.

Development of a haze meter for use in flat country has progressed sufficiently so that Byram has prepared specifications for a new model. It will be built in time to permit tests during the coming spring fire season. Instead of using ridges lying at different distances from the lookout as targets, it is believed that the shaded sides of clumps of trees at known distances from the observer can be used. If so, a change in the photometric part of the meter is required but the fundamental principle will remain the same.

A rather heavy load of routine plot examinations was completed. Data have not been sufficiently analyzed to report results.

A study of the weather which prevailed prior to the largest and severest fires which occurred during the past 20 years and an analysis of weather during fire seasons during the past 11 years on the Pisgah National Forest, has almost been completed.

Considerable progress has been made in the preparation of rainfall probability maps for the Station's territory. It appears that summaries by 5 day periods, in amounts of 1/2 inch or more, is the best break down.

Plans for 1937

Work will be continued with the object of developing standards of detection coverage. Haze meter records will be analyzed to obtain average radius of vision figures for use in planning detection systems. In addition, if a method of forecasting poor visibility can be found, the placing of emergency forces will be facilitated.

Where requested, assistance will be given to forests beginning detection planning projects.

It is hoped that a complete analysis can be made of records from permanent sample plots in the Coastal Plains, some of which have been burned every year for the past six years. This will include a comparison of burned and unburned areas as to mortality, height, diameter, and volume growth, and effect of fire on reproduction.

A working plan has been prepared for the study of the effect of fire on rate of growth in a young oak stand. The preliminary study will be completed during the year.

Investigations on inflammability, rate of fire spread, and fuel moisture relationships as influenced by weather will be started.

A preliminary fire danger meter will be prepared.

The Station will make recommendations and assist the Regions in the establishment of fire weather stations, in the preparation of record forms, and in training some observers.

Forms and instructions will be prepared for the cooperative study on going fires, of rate of perimeter increase, and held line construction, and will assist in training some of the specially designated CCC observers.

The Station expects to cooperate with the national forest regions in setting up standards for fuel type mapping.

Urgent Problems

The most important fire problem in the Station's territory is the reduction of man-caused fires. This will require an investigation of the underlying causes and remedies to be used. It seems that such a study does not lie within the scope of the Station, particularly since a trained psychologist is to be employed by the Division of Fire Control, and since

cooperative projects with psychologists in educational institutions are contemplated.

An analysis of fire records to provide specific information on rate of spread and resistance to control is urgently needed. Among the factors which should be considered are slope, exposure, wind, size upon arrival, strength of attack, and chains of held fire line per man hour.

Further studies on the relation between fire wounding and losses from decay in mountain hardwoods are needed. This is essentially a problem for Forest Pathology.

——— Ralph M. Nelson

FOREST INFLUENCES

Accomplishments During the Past Year

At no time in past history has the subject of land management in relation to regulation of streamflow, floods and soil protection received a greater public interest than today. As a part of the general inquiry into land management, forest cover in relation to stream behavior has become a subject of much concern to land planning committees. Recent floods have called nation-wide attention to the need for a comprehensive national program for reducing and averting flood damages in the future. The extensive development of hydroelectric power and navigation calls for fullest use of every practical method of regulation of streamflow.

Conservancy agencies such as the Miami and Muskingum Districts are being pointed out as successful engineering accomplishments for the reduction of flood damage. The Mississippi flood control system of high levees and diversion spillways has proven itself to be effective flood control engineering, so far as aiding in the control of flood waters once they have accumulated in the major stream channels is concerned. The public can be easily interested in these engineering programs because they can see and understand tangible structures such as dams, levees, spillways and reservoirs. The accomplishments of forest or other plant cover as contributions to flood control and stream regulation are less easy to demonstrate than are the engineering structures that are designed to control the flood waters after they reach the major rivers. Until recently, the Forest Service has lacked accurate records to indicate the effect of forest land management in relation to run-off and streamflow. Without such records, it will be impossible to establish the part forests can serve in streamflow protection.

The Forest Influence Division of the Appalachian Station is undertaking to determine through carefully controlled scientific studies, what forest management can contribute to watershed protection.

As a first step toward comparing the relative efficiency of forest cover with other watershed conditions for streamflow protection, the Station is obtaining a continuous record of the behavior of a number of small streams arising from drainage areas made up of forested and wild land.

Major Installations Developed

Forest influence investigations have been carried out principally at three field centers, the Coweeta Experimental Forest, the Bent Creek Experimental Forest and the Copper Basin of Tennessee. Of these three centers of activity, the Coweeta Experimental Forest has been selected as a major installation in a national program of forest influence investitations, as representing the high rainfall belt of the Southern Appalachian Mountains. The area has been intensively developed for water yield studies and promising results have already been obtained during the first two and one-half years of active operation of the area. Through the invaluable cooperation of the Nantahala National Forest Administration, the area has

been able to partially complete a road and trail building program, making accessible the more remote sections of the Forest, and taking precipitation and other meteorological records, and for the major stream measuring installations.

Similarly, the meteorological and watershed studies within the Copper Basin of Tennessee have been developed in keeping with the original plan for the area. In this development, valuable assistance and cooperation have been furnished through the Supervisor's office of the Cherokee National Forest. The original forest influence installations on the Bent Creek Experimental Forest have been operated and maintained during the past year.

The following table indicates the progress of this study.

Small Streams for Which Continuous Records are Being Obtained January 1, 1937.

Bent Creek Experimental Forest
Buncombe County, N. C. (Annual precipitation 45 inches)

Stream No.	Area Acres	Nature of Vegetation	Recorder Installed	Records Available
1	49	Forested. National Forest.	June 22,1933	3 yrs.7 mos.
2	17	Forested. National Forest.	Aug. 14,1933	3 yrs.5 mos.
3	11	Abandoned farmland. Pastured.	June 7,1934	2 yrs.7 mos.
4	774	Forest; some abandoned fields.	July 5,1934	2 yrs.6 mos.
5	90	Forested. National Forest.	Aug. 17,1934	2 yrs.5 mos.
6	72	Forested. National Forest.	Aug. 17,1934	2 yrs.5 mos.
7	-	Forested. National Forest.	Sept.13,1934	2 yrs.4 mos.
8	16	Abandoned agricultural land.	Oct. 5,1934	2 yrs.3 mos.

Copper Basin Experimental Area
Polk County, Tennessee. (Annual precipitation 55 inches)

1	19	Forested. National Forest.	Nov. 26,1934	2 yrs.2 mos.
2	89	Forested. National Forest.	Nov. 26,1934	2 yrs.2 mos.
3	6	Grassed. Broomsedge.	Feb. 12,1935	1 yr.11 mos.
4	7	Grassed. Broomsedge.	Feb. 12,1935	1 yr.11 mos.
5	16	Denuded.	Jan. 21,1935	2 yrs.0 mos.
6	5	Denuded.	Dec. 31,1934	2 yrs.1 mo.

Coweeta Experimental Forest
Macon County, N. C. (Annual precipitation over 70 inches)

1	39	Forested. National Forest.	June 13,1934	2 yrs.7 mos.
2	31	These watersheds are all on the	June 22,1934	2 yrs.7 mos.
3	23	5000-acre Forest Influence Ex-	July 5,1934	2 yrs.6 mos.
4	10	perimental Area within the	June 28,1934	2 yrs.7 mos.
5	4	Nantahala National Forest. The	June 30,1934	2 yrs.7 mos.
6	22	area is representative of the	July 10,1934	2 yrs.6 mos.
7	145	high value protection forest	July 31,1934	2 yrs.6 mos.
8	1912	within the 70 to 100 inch rain-	Oct. 9,1934	2 yrs.3 mos.
9	1790	fall belt of the Southern Ap-	Oct. 13,1934	2 yrs.3 mos.
10	224	palachian Mountains. A small	March 7,1936	10 mos.
11	440	percentage of the area is now	March 5,1936	10 mos.
12	502	restocking old field, but for		
13	42	the most part, the cover re-	Mar. 12,1936	10 mos.
14	152	presents a hardwood forest 20	May 26,1936	8 mos.
15	942	years after a heavy commercial		
16	943	saw log cutting.	June 25,1936	7 mos.
17	28		June 4,1936	7 mos.
18	31		July 2,1936	6 mos.
19				
20				

Unit Yields of Mountain Forest Areas are High

The two major streams of 1700 and 1800 acres each, draining the Coweeta Experimental Forest, have produced yields of water which, when put on a unit run-off basis as base flow, are exceedingly high for streams of this size. The average base flow for the six-month period of November 1, 1935 to April 30, 1936, amounted to 5.02 and 4.32 c.f.s. per square mile for the two watersheds respectively. That forested watersheds in the Southern Appalachians are able to produce base flow averages of this magnitude is an important fact in land management of the region. Although this six-month period was one of high precipitation, a base flow of this magnitude indicates remarkable streamflow control exerted by the forest cover present. Particularly is this demonstrated by the fact that of the total precipitation recorded as run-off, 80.6 and 78.9 percent of the total flow occurred as seepage flow and only 19 and 21 percent as stormflow.

Peak Flows Reduced on Forested Watersheds

The following table is an example of results that have been obtained by comparing run-off records of small watersheds, each representing a single type of vegetative cover. These records were obtained from watersheds within and adjacent to the Bent Creek Experiment Station, Buncombe County, North Carolina.

Watershed No.	Area in Acres	Average peak flow for 19 storms of approximately 2 inches each Expressed as c.f.s. per sq. mile
1 - Forested	48.6	16.4
2 - Forested	17.3	16.8
5 - Forested	90.4	15.0
6 - Forested	71.5	19.4
8 - Abandoned farm land	16.3	155.4
3 - Abandoned & pastured	10.8	316.2

Important flow characteristics of small tributaries are ironed out within the branch streams and in the same manner differences in flow of branch streams become lost in the major streams. Hence it is necessary that records be obtained for streams from watersheds of different characteristics as to shape and size. It has been with the idea in mind that records must be obtained on both small and large watersheds, that the Coweeta Experimental Forest has been intensively developed as a forest influence study. Within this area stream behavior is being recorded and analyzed for the major streams and also for the smaller tributaries of which they are made up. In this manner it will be possible to obtain a measure of unit yield for the area as a whole and at the same time to analyze the factors that influence the behavior of smaller streams. Once a reliable comparison of streamflow for existing forest cover has been established for the tributary watersheds of the Coweeta, the plan is to apply various kinds of treatment to the forest cover, in order to determine the effect of forest management on streamflow and erosion.

Denudation Influences Local Meteorological Conditions

A continuous record for two full years is now available for the three complete meteorological stations that have been maintained by the Experiment Station within the Copper Basin of Tennessee. These three meteorological stations represent forest cover, broomsedge, and completely denuded areas. A summary of the results to date indicate that complete denudation of a large area by smelter fumes has brought about conditions simulating desert. Low rainfall, excessive evaporation, high temperatures and high saturation deficits are characteristic. The absence of insolation has produced marked diurnal temperature changes. A table was given in the Station's 1935 Annual Report showing the trend of the data. In the fall of 1935, three additional meteorological stations were established in the Copper Basin as a check upon the results obtained in the three original stations. Results for two full years are now ready for publication.

Water Cycle Studies Completed on Interception by Crown Canopies

During the past year, the Station has completed a three-year study of the interception of precipitation by crown canopies. All data have been analyzed and are now ready for publication. In these studies the records were obtained to compare the amount of precipitation reaching the ground under the crown canopies with the total amount of precipitation recorded in standard rain gauges placed above the canopy. The precipitation reaching the ground was caught in specially designed trough-shaped rain gauges which collected the rain dripping through the tree canopies, and in collar-like troughs placed around the bole of the tree to collect the water which would otherwise reach the ground along the tree boles.

Records were obtained for the interception of the canopies of the following four forest types:

1. Oldgrowth hardwoods.
2. Yellow-pine hardwoods.
3. Mixed hardwoods with laurel understory.
4. Thirty-year oldfield pine.

AERIAL INTERCEPTION
(Hardwoods)

Inches Precipitation	Inches Precipitation Intercepted by Crown Canopies	Inches Precipitation Drained Down Boles	Inches Precipitation Lost To Soil Because of Aerial Interception	Inches Precipitation Reaching Ground
.20	.05	.00	.05	.15
.40	.06	.00	.06	.34
.60	.08	.00	.08	.52
.80	.09	.00	.09	.71
1.00	.11	.01	.10	.90
1.20	.12	.01	.11	1.09
1.40	.13	.01	.12	1.28
1.60	.14	.02	.12	1.48
1.80	.14	.02	.12	1.68
2.00	.15	.02	.13	1.87
2.20	.15	.02	.13	2.07
2.40	.16	.03	.13	2.27
2.60	.16	.03	.13	2.47
2.80	.16	.03	.13	2.67
3.00	.17	.04	.13	2.87
3.20	.17	.04	.13	3.07
3.40	.18	.04	.14	3.26
3.60	.18	.04	.14	3.46
3.80	.18	.04	.14	3.66

AERIAL INTERCEPTION
(Pines)

Inches Precipitation	Inches Precipitation Intercepted by Crown Canopies	Inches Precipitation Drained Down Boles	Inches Precipitation Lost To Soil Because of Aerial Interception	Inches Precipitation Reaching Ground
.20	.06	.00	.06	.14
.40	.09	.01	.08	.32
.60	.12	.02	.10	.50
.80	.14	.02	.12	.68
1.00	.16	.03	.13	.87
1.20	.18	.04	.14	1.06
1.40	.20	.05	.15	1.25
1.60	.22	.06	.16	1.44
1.80	.24	.07	.17	1.63
2.00	.26	.07	.19	1.81
2.20	.28	.08	.20	2.00
2.40	.29	.09	.20	2.20
2.60	.30	.09	.21	2.39
2.80	.31	.10	.21	2.59
3.00	.32	.11	.21	2.79
3.20	.33	.12	.21	2.99
3.40	.34	.12	.22	3.18
3.60	.36	.13	.23	3.37
3.80	.37	.14	.23	3.57

Technique of Watershed Studies Developed

Although continuous records for at least five years are planned as a minimum period for the standardization of small streams in order to determine their general behavior, certain trends of behavior are so apparent even after two years' observation that some tentative conclusions may be drawn from the analysis of records.

Among the results that have an immediate application to the science of forest influences are those obtained through a comparative study of the unit base flow of small tributary streams, and the larger streams of which they are a part. For example, within the Coweeta Experimental Area, records are available for a number of tributary streams arising on small drainage areas that together make up the watersheds of the two major streams of the area. The following table indicates the general relation between the size of the watershed and the mean base flow obtained for three successive six-month periods.

Stream No.	Area Sq.Miles	Cubic feet per second per sq.mile--base flow: Nov.1,1934 to April 30,1935	May 1,1935 to Oct. 31, 1935	Nov. 1, 1935 to April 30, 1936
3	.036	1.070	0.717	2.198
2	.048	1.276	0.754	3.335
1	.061	1.858	1.262	3.228
7	.227	2.202	1.610	3.847
9	2.660	3.827	1.778	5.022
8	2.900	3.476	1.894	4.324

These data indicate that there is in general an increase in the unit base flow with the increase in size of the watershed. The ratio of increase is not constant, and for the two largest streams the base flow is actually higher in two of the six-month periods than in the case of the smaller watershed. It must be concluded, however, that for the Coweeta Area as a whole, the larger watersheds furnish a much more significant unit base flow than do the small watersheds. Consequently, so far as the study of vegetative cover in relation to water yield in mountainous country is concerned, it would seem that watersheds should be of sufficient size to produce a base flow that approaches a maximum unit flow for the region. Indications are that this maximum base flow will not be obtained on drainages of less than 500 or 1000 acres within an area of steep topography. It is reasonable to believe that in regions of lesser relief, a still much larger watershed would be required to obtain an accurate record of maximum base flow per unit square mile.

The location of small watersheds in relation to the land mass with which they are associated is an important consideration in a study of water yield. Small drainages near the valley floors located on the sides of interstream ridges, frequently produce unit base flow far in excess of flow from drainages of equal area but located in the uppermost headwaters of the same watershed of which both streams are a part. As an extreme example, a flowing spring may have no drainage associated with it, so far as surface

terrain is concerned, however the spring does represent some seepage water that originated from precipitation fallen on some land surface elsewhere. Records that have been obtained from very small watersheds lying close to the valley floor on the Coweeta Forest clearly indicate that the flow of these streams is influenced by seepage from the land mass lying at higher elevations, and that as a consequence, the flow from these streams is not related directly to the surface area of the watershed ascribed to the stream.

In addition to location in relation to land mass, small watersheds are likely to differ in their behavior due to other inherent factors that would be less evident in large watersheds of several square miles in area. It has been found that two adjoining watersheds of similar size may differ greatly in seepage flow. An example of this difference is found in streams #5 and #6 on the Bent Creek Experimental Forest.

	Cubic feet per second per sq.mile--base flow		
	Nov. 1,1934 to April 30, 1935	May 1,1935 to Oct. 31, 1935	Nov. 1, 1935 to April 30, 1936
Stream #5 (90 acres):	1.291	0.476	1.742
Stream #6 (71 acres):	2.998	1.304	3.690

Although larger watersheds are desirable for the study of yield, at the same time, to study the influence of vegetative cover upon surface stormflow and soil erosion, or upon transpiration draft, evaporation and certain other phases of consumptive use, it becomes necessary to obtain records from smaller watersheds because it is impossible to obtain extensive areas of uniform vegetative cover, particularly for wild and abandoned land in the southeastern states.

Infiltration of Water into the Soil

During the year, Dr. Jacot has completed a preliminary study of infiltration of water into the soil as it is influenced by microarthropods and other soil insects. He has found that the upper inch or two of the mineral soil of woodlands harbors from 1000 to 2000 minute arthropods per square foot of surface. Although 20% of these animals are predaceous and parasitic, the remainder are either burrowing about through the soil in search of food or are eating out dead roots and rootlets. Some of these minute soil burrowers are built like a mole and channel about through the soil much as do moles, thus making the soil much more porous and full of minute rain-water conduits. Of far greater importance, however, are those animals which hollow out the plant rootlets. Since some grass plants develop as much as seven miles of rootlets in three years and as many of these rootlets die beginning with the third year, there is a great deal of soil channeling in grassland due to the combined action of herbaceous plants and dead-root eating microarthropods. Any soil covered by annuals is annually stocked with dead rootlets which are annually eaten out by these minute animals. As these rootlets begin with a fairly stout tap root, or cone of root-bases, and branch out in all directions from this center, it becomes immediately evident that any rain water which enters this larger central conduit is rapidly dispersed throughout the surrounding soil. Although such water distributing systems are very small and of fine caliber, they make up in numbers what they lack in size, -- provided the forest floor is well carpeted with herbaceous vegetation.

Moreover, these animals convert the dead roots and rootlets into fine, black faeces. In time the entire soil becomes transformed to that fine, black soil we call mull.

Below the upper two inches of mineral soil the numbers of microarthropods become less, corresponding to the reduction of the root systems. For example, at a depth of twelve inches, several microarthropods were recovered, at least one species of root-eater having never been found elsewhere. How far down these root-eaters will follow the plant and tree roots has never been determined. Their effect on aeration and nitrification of the soil at some depth must be an important factor, but their greatest interest and usefulness is believed to be in decreasing run-off by filling the upper inches of soil with a rapid-distribution system for rain water.

Direct Seeding Studies (Erosion Control)

Additional results have been obtained which modify the report on direct seeding studies appearing in the "Investigative Program" of February 26, 1936. This study consists of observing the growth of forest trees planted by different methods of direct seeding in one-tenth acre plots. The planting on the Coweeta Experimental Forest was done in the latter part of May 1935, using seed that was stratified in sand and placed in cold storage for six to eight weeks, or else treated with sulphuric acid before planting. The results of the seedling count 60 days after planting indicated a very high survival rate, but the exceedingly severe winter of 1935-36 killed a great number of the seedlings by frost heaving. The plants were literally picked out of the ground exposing the roots to the sun. A comparison of the results of the sixty-day count in 1935 and the one and one-half year count in January 1937, based on the 38 plots in the Coweeta Experimental Forest, is shown in the table below. Percent figures indicate the extremes by individual plots, expressed as a proportion of the number of living seedlings to the number of viable seeds planted.

Percent Survival Under Broadcast and Spot Seeding

	Shortleaf Pine		Loblolly Pine		White Pine		Black Locust	
	1935	1937	1935	1937	1935	1937	1935	1937
	%	%	%	%	%	%	%	%
Broadcast Seeding	0 - 0	0 - 0.4	0 - 0.3	0 - 4.9	0 - 0.3	0-0.1	0 - 0	0 - 0
Spot Seeding	2.3-19.3	0.6-8.9	9.1-52.0	4.4-22.3	0.2-1.0	0-3.7	7.5-15.1	1.1-4.1

The increase of the 1937 over the 1935 count of broadcast shortleaf pine was due to the uncertainty in counting sixty-day old plants in broomsedge cover.

Plans For 1937

Permanent C.C.C. Camp Imperative to Maintenance of Coweeta Forest

The operation and maintenance of the present forest influence studies will occupy the full time of the present personnel assigned to the project. However, most of the present project personnel are under temporary or emergency allotments. The C.C.C. Camp N.C. F-23, located on the Coweeta Experimental Forest, has been indispensable to the development of the Area for scientific studies. An entire camp is at present required for the development and maintenance of the Area under existing high scientific standards, and the removal of the camp will result in greatly lowering the present standards, if not in actually making it impossible to proceed with the type of work now being done.

Measurement of Watershed Control by Different Types of Land Use To Continue

The stream measurement and watershed standardization will be continued on the 30 established weir installations on the three centers of the forest influence studies. Although the behavior of a number of these streams already indicates that they may be sufficiently well standardized to proceed with the second phase of the watersheds in which the present vegetation cover will be changed, under the present plans of the experiment no changes will be made on any of the watersheds during the coming year. It is believed that an additional one or two years' standardization for the streams before any alteration is made of the present vegetation cover can not possibly detract from the soundness of the studies, whereas changing the period may prove to be undesirable. This is particularly true in the sense that, up to the present time, no extreme drought periods have obtained.

The plan is to equip all of the usable tributaries of the Coweeta watershed with measuring devices and subsequent use for studies of forest management practices on streamflow.

Meteorological Stations Will be Maintained

All meteorological stations relating to watersheds on which stream measurements are being made will be maintained in the same manner as in the past, providing personnel is available. Within the Copper Basin, the six Class-A meteorological stations will be serviced twice daily, using automatic instruments for wind velocities, precipitation intensity, soil and air temperatures and air saturation deficits. If possible, recording microbarographs will be installed at least at two meteorological stations within the Copper Basin, one representing complete denudation and the other forest cover. It is also planned to make an estimate of the heat radiation and temperatures obtaining above the denuded portion of the Copper Basin as compared to the grass and forest zones. More intensive studies of the saturation deficit are also planned.

Water Infiltration Into the Soil

No intensive studies are planned in the field of forest soils other than an office summary of reports and data collected by emergency personnel during the past three years. These summaries will refer particularly to taxonomic classification of soil horizons in the Southern Appalachians, and to soil profile changes through depletion and subsequent rehabilitation by vegetative cover.

Additional Studies of the Water Cycle

Data obtained during the past two and one-half years on the aerial interception by tree canopies are being analyzed for publication. It now appears that sufficient data have been obtained for the forest types under observation, and that the present interception studies will be discontinued. A preliminary review is also being considered, which will bring together existing information on the subject of forest transpiration, and a working plan will be proposed as to what would be an acceptable approach for the Appalachian Station to make within this field.

Watershed Improvement

In the field of watershed improvement, the project anticipates no further field studies other than are incident to the protection of National Forest roads on experimental areas where it is desirable to try out unproven methods of planting, mechanical structures, slope and similar means of road protection which can be tried out more satisfactorily on experimental areas than elsewhere.

Urgent Problems

Development of Additional Experimental Areas

Under the present project allotments, no additional installations can be made during the coming year, although it would be desirable to obtain hydrological and meteorological data in the Piedmont and in the Cumberlands, as representative regions of the southeast not now covered by the Station's forest influence project.

Rate of Infiltration by Different Humus Types

In connection with the general land use planning for the southeast, frequent requests are being made by different agencies as to the infiltration rate of different soils modified by different forms of land use. Apparently, the most desirable procedure for obtaining satisfactory coefficients of infiltration on a large number of different areas is by the use of small run-off plots and artificial sprinkling devices to simulate natural precipitation. The equipment and apparatus for such devices is relatively expensive, and these studies will not be undertaken unless adequate personnel and overhead costs are provided for.

_____ C. R. Hursh

FOREST SURVEY

Accomplishments During the Past Year

The active participation of this Station in the Forest Survey began in April, 1936, with the appointment of a survey director. The period April to July was spent in reviewing survey work in other regions, particularly in the South, and in the preparation of plans for initiating field work in this region.

With the limited funds available in the fiscal year 1937, it has been advisable to continue the field work in South Carolina, where the Southern Forest Experiment Station had already completed one unit. It was estimated that the ECW period until March 31, 1937, would be required to complete the work in South Carolina.

The procedure adopted followed closely that developed by the Southern Station. Two field units of 6 to 8 million acres each were set up and parallel lines were run across them at 10 mile intervals in a northeasterly direction. Quarter acre sample plots were taken at 10-chain intervals on each line.

Field work was begun in July, 1936, with 6 three-men crews. Favored by unusually good weather, the experienced crews pushed the work rapidly and both units, completing line plot work in South Carolina, were finished in December, 1936. The field work was then initiated in the North Carolina Piedmont area, and by the first of April approximately 10 million acres, or 95 percent of this unit were covered.

Compilation and tabulation of the field data was started immediately following the completion of the coastal unit in South Carolina. The machine tabulations are being made at the Southern Station and the final computations will be completed in Asheville. Machine tabulations for one South Carolina unit are nearing completion and the preliminary tables should be ready shortly. The tabulations on the South Carolina Piedmont unit will not be completed for several months on account of a shortage of funds.

Volume tables for the South Carolina coastal unit and for the Piedmont units of both South and North Carolina were prepared by James W. Girard. The International 1/4-inch sawkerf scale is being used as the basic log scale for all board foot tables. Total net timber volume will be shown also in Scribner and Doyle scales.

Inventory of the drain on the timber stands of the Region by wood-using industries and by local consumption is expected to start within the next month.

Plans For 1937

The plans for extension of the Survey in the territory of this Station during the coming year, of course, are dependent on the funds made available during this period. There is urgent need for data in the Coastal Plains Region of North Carolina and Virginia to assist in solving some of the problems arising as a result of the expansion of the wood-pulp industry in the Region. Completion of the Piedmont and the mountain areas of North Carolina, Virginia, West Virginia, Kentucky and Tennessee is likewise important. The exact order in which these areas can be worked will depend upon the funds made available and to some extent the climatic factors involved.

During the year it is planned to complete organization of a computing section in Asheville to handle compilations of field data and growth calculations. An economics section will also be established to analyze the data and prepare reports on the findings. It is hoped that reports on the two South Carolina units can be completed this year and that at least preliminary figures will be available for the North Carolina Piedmont Region.

——— E. V. Roberts

FIRE WEATHER

In Cooperation with Weather Bureau

The long-contemplated extension of the Weather Bureau's Fire-Weather Service to include Virginia and West Virginia was accomplished in 1936. Ten new stations, four in West Virginia and six in Virginia, were opened, and beginning with the spring fire season of 1937, daily forecasts will be sent to key points in these States. Communication appropriations have not been large enough to give as wide a distribution to forecasts as is desired, but with the extension of radio communication within forest areas, distribution will be greatly improved.

High points were selected for a few of the new stations in order to determine humidity variations with elevation. Preliminary studies showed that on October 31, 1936, a relative humidity of 10 percent obtained at 1:40 a.m. on the summit of Mt. Mitchell, 13 percent at 8:00 a.m. on High Knob Lookout, near Norton, Virginia, and 11 percent at 1:00 p.m. on Reddish Knob Lookout, on the Virginia-West Virginia line. Supervisors and Rangers undoubtedly know that ridges dry out first, but it is believed they might not realize that relative humidity goes to any such "powder keg" levels. More complete studies along this line will be undertaken.

Forecasts and research studies are based upon observations made by the reporting stations and suggestion is made that Supervisors having Fire-Weather stations in their areas aid in getting reliable observations from these stations. As a whole, the cooperation and reports are good, but the need for accuracy and reliability in making observations cannot be overemphasized.

Mr. H. A. Downs, Fire-Weather Official at the Asheville station, is now in Washington, D. C., where he is taking a special course in Air Mass Analysis. This is a comparatively new phase of Meteorology and will be of inestimable value in the forecasting connected with the work in this area.

——— Harry A. Downs

By Paul F. Sutton

FOREST PATHOLOGY

In Cooperation With
Bureau of Plant Industry, Division of Forest Pathology

Accomplishments During the Past Year

A forest pathologist loaned from the New Orleans branch worked out of the Appalachian Forest Experiment Station the first two months of this fiscal year. This time was devoted to three problems; the deterioration of blight-killed chestnut, the hemlock twig blight, and the wilt of mimosa.

An ECW pathologist spent part time in the territory establishing plots in sprout oak on the George Washington National Forest, designed to help determine those cutting practices likely to result in the least decay in oak sprout reproduction, and another spent 3 months cooperating with the entomologists on fungi that follow bark-beetle attack. A little attention was given to nursery diseases, mainly in Region 7, by ECW pathologists. There is no pathologist regularly stationed in the territory.

In response to the requests of two chestnut extract and pulp companies an effort was made to find out whether the blight-killed chestnut was deteriorating more rapidly than had been expected. The results of a brief study, incorporated in a report entitled "The condition of dead chestnut being cut for acid wood in some parts of the Southern Appalachians" indicated the rate of decay of such wood to be very slow. Brashness and certain other undesirable features of the wood were found to be correlated with growth rate and dryness more often than with decay.

Losses from the hemlock twig blight, found to be caused by an autoecious rust fungus, were as large or larger than last year at certain commercial nurseries. Many thousand dollars worth of ornamental stock has been rendered unsaleable. The disease was also present in natural stands of hemlock, but caused less damage. Control measures could probably be worked out for nurseries but would not be practicable in forests.

The mimosa wilt has been found at a few additional places in South Carolina. Additional evidence that it is caused by a Fusarium has been obtained. The State of North Carolina started an eradication program at Tryon, North Carolina.

Plans For 1937

In the absence of funds for research in the Appalachian Region, no formal program of work in this Region is being formulated for next year. Further work on some of the more urgent problems will be attempted if possible.

Urgent Problems

Fire damage studies involving the determination of the amount of fungous defect that develops in standing timber following fires of different intensities. Such information is essential for damage appraisal.

Control measures for the hemlock twig blight. The heavy losses now being sustained at commercial nurseries make this an urgent problem.

Life history studies of mimosa wilt fungus, leading to better control recommendations.

Decay in sprout hardwoods in the southern part of the Appalachians.

Nursery disease investigations.

Blue stain in pulpwood for newsprint.

Logging damage leading to trunk rot and cankers.

——— George H. Hepting

FOREST ENTOMOLOGY

In Cooperation With
Bureau of Entomology and Plant Quarantine

Only E.C.W. funds are used for the investigative work carried on by the Asheville Station of the Division of Forest Insect Investigations. These funds are used to continue projects started prior to E.C.W. and for those projects necessitated by C.C.C. activities. The commencement of investigations of some urgent forest insect problems has been delayed because of the limitation of funds.

Accomplishments During the Past Year

The white grub and June beetle investigations as continued have demonstrated that

1. Many chemicals, especially those containing arsenic, previously suggested and recommended as soil treatments for grub control are not only ineffective against the insect but decrease seed germination and/or are otherwise deleterious to seedling development;

2. Ridding a seedbed or entire nursery of grubs before or at the time of seeding will not prevent serious grub injury that same year in the south;

3. Mechanical barriers prevent grub damage by prohibiting oviposition in and grub migration into seedbeds;

4. Some chemicals, particularly paradichlorobenzene, showing promise in the 1935 tests, are useless as regards prevention and control;

5. There is promise of grub control in nursery beds by means of proper applications of carbon disulphide and/or carbon disulphide emulsion.

In addition, the study gave valuable leads that will be followed carefully; also, important information as regards the life histories of the various white grub species was forthcoming.

The tree medication study revealed a tremendous amount of information as regards the technic of treatment, the distribution of a chemical in the tree, and the preservative values of the chemicals used.

While the data from the study of seasonal moisture variation in pines as carried on in 1935 and continued through 1936 is not completely analyzed the indications are that there is a definite change from season to season in the moisture content, high in winter and spring to low in summer and fall, and that this seasonal change continues year after year.

The bark beetle, yeast, and blue stain study, a complicated problem of interrelationships, was carried somewhat further during 1936. One new yeast was described; and, the technic of rearing bark beetles under aseptic conditions from the egg to the adult stage was greatly improved.

Data concerning plant development and succession on all the Dendroctonus frontalis plots were collected but final analyses are not completed.

A dearth of southern pine bark beetles during the past two years prevented the continuation of brood control and life history studies.

Plans For 1937

The white grub and June beetle investigations will be continued, concentrating the work as during the past two years at Georgetown, South Carolina. A number of new tests are planned; these in addition to the going tests.

Tree medication work will be continued on a slightly modified form. Also, an effort will be made to develop a technic with a newly suggested chemical whereby tree infesting insects may be destroyed without the attacked tree being damaged.

A study involving means and methods of controlling insects infesting forest products will be begun.

An investigation into the correlationship between hickory seasoning (reserve food depletion) and Lyctus powder-post beetle attack and injury will be started.

Provided southern pine beetle attacks are found or can be induced, studies of control and life history will be continued.

Urgent Problems

Pine tip moth studies in pine plantations.

White grub studies in plantations and proposed planting sites.

Investigations of insects as concerns pine pulpwood.

——— B. H. Wilford

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